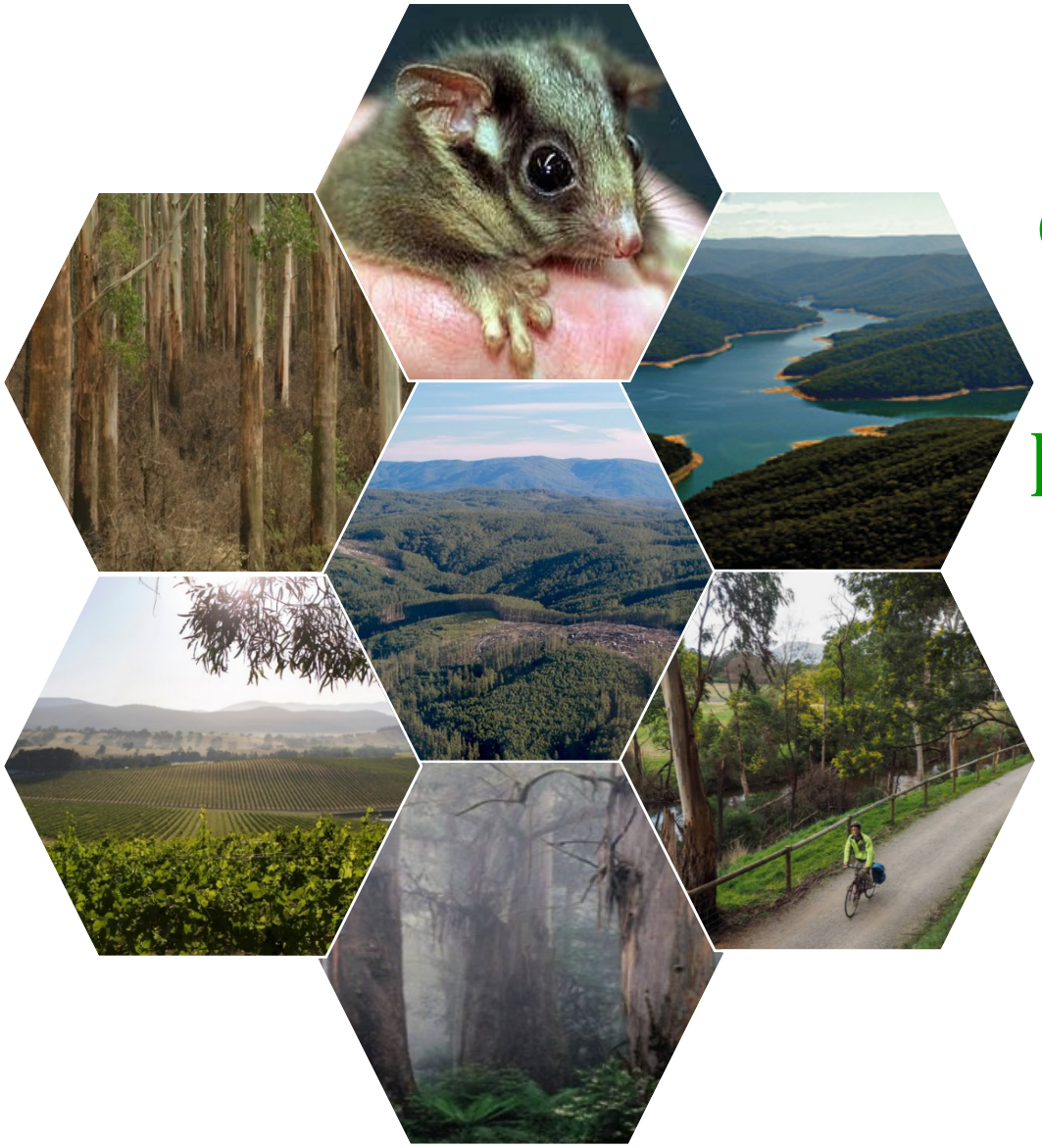

Developing forest environmental-economic accounts for informing policy and decision making

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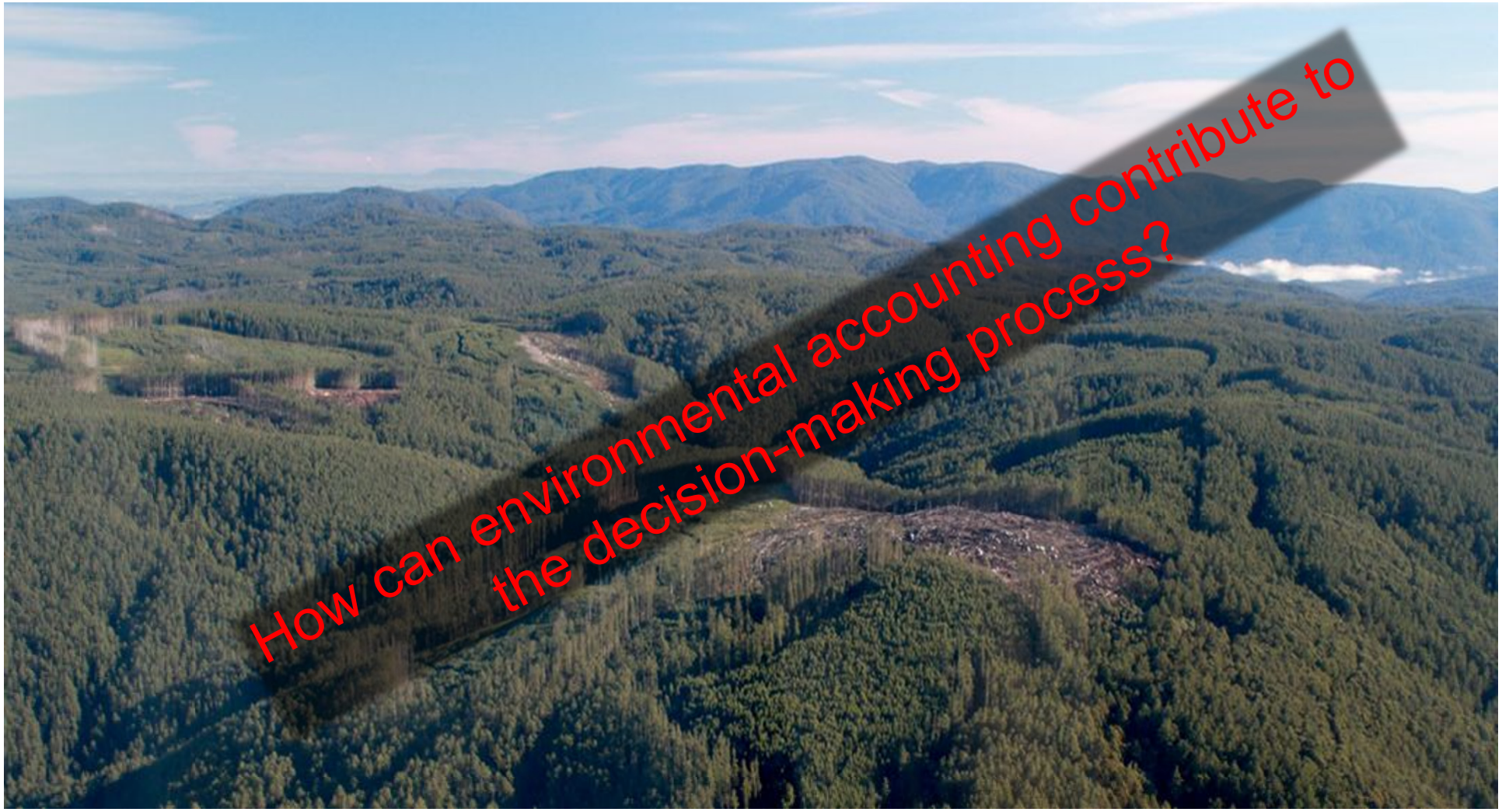
Australian National University

Forest Ecosystem Services Forum, Wellington, New Zealand, 8th May 2018

A contested landscape:
forest management in the Central Highlands of Victoria, Australia



Outline

1. Land management issues

2. Objectives

3. Ecosystem accounts
- land, timber, water, carbon, biodiversity

4. Interpretation
– analysis of results providing information relevant to land management policy

5. Information for policy

6. Lessons learned

Central Highlands study region

Use of ecosystem services can be complementary or conflicting

Industries dependent on ecosystem services from the Central Highlands region

Water supply

Tourism

Native timber

Carbon sequestration

Agricultural production

Plantation timber

Water and carbon assets

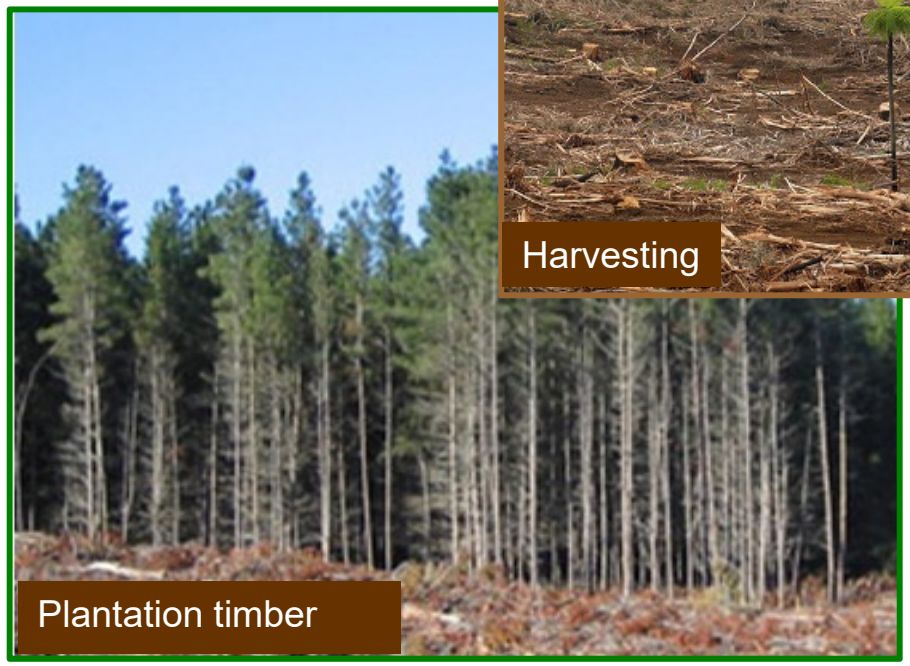
Timber assets


Native timber


Harvesting

Paper products


Timber


Plantation timber

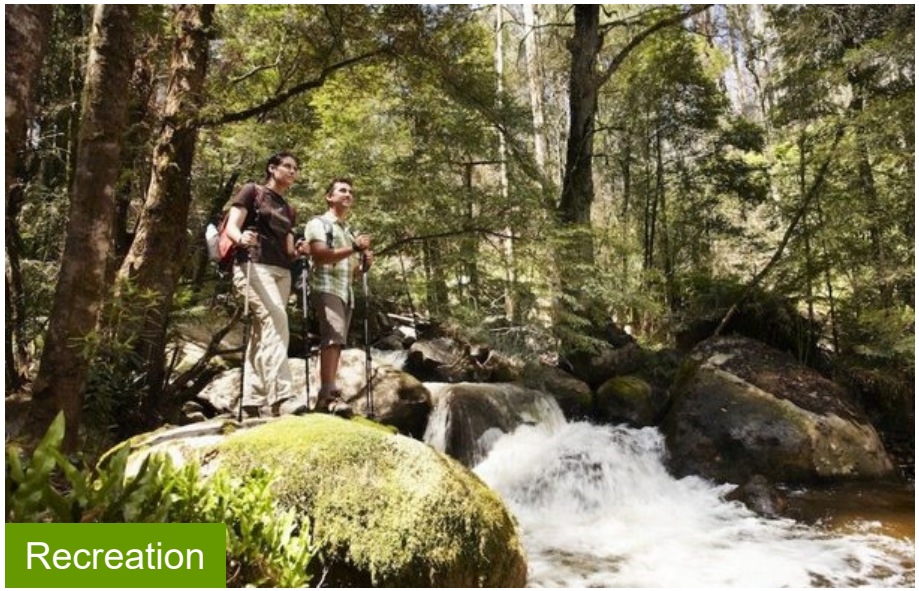

Regeneration

Sawlog products

Agricultural and recreational assets


Cropping and horticulture


Grazing


Recreation

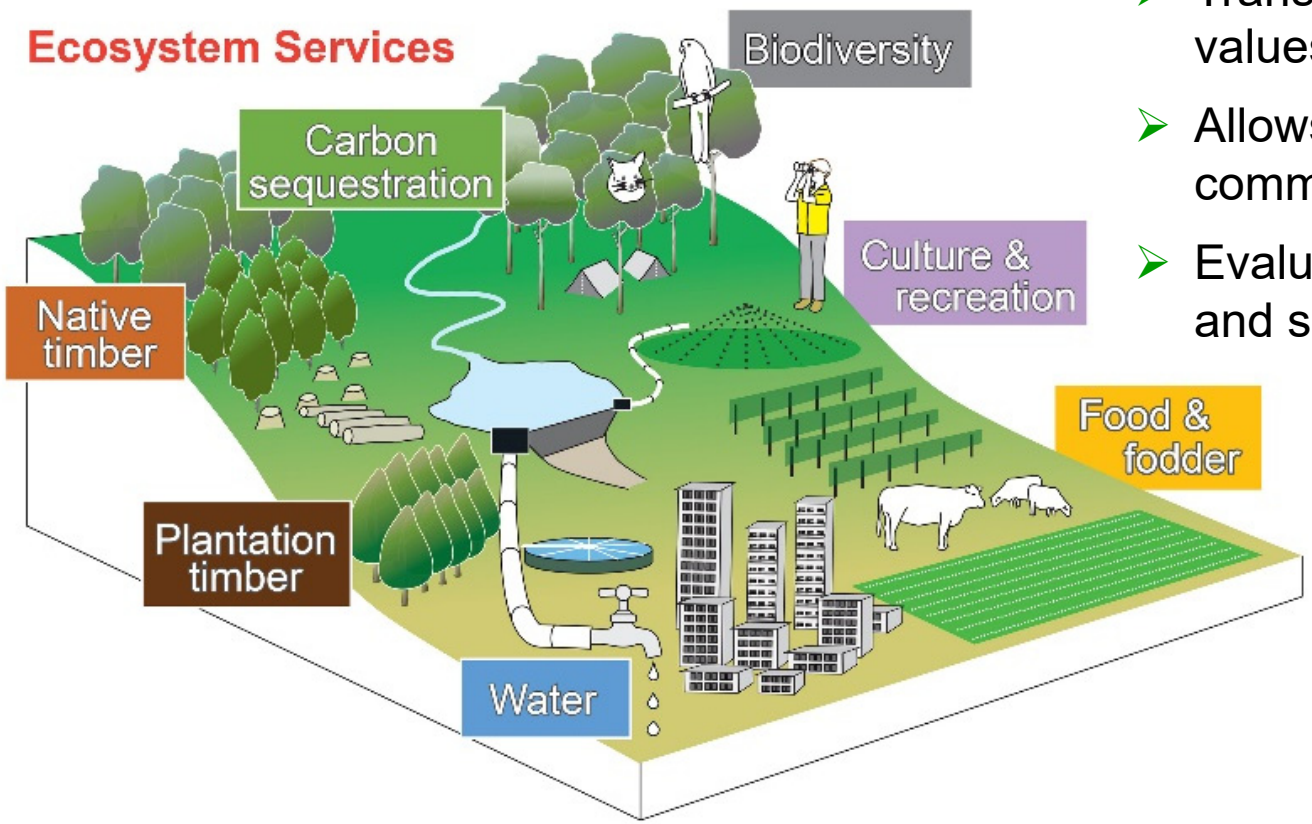

Recreation

Biodiversity assets and aesthetic values

Photos: Dave Blair, Chris Taylor and Heather Keith

Ecosystem accounting

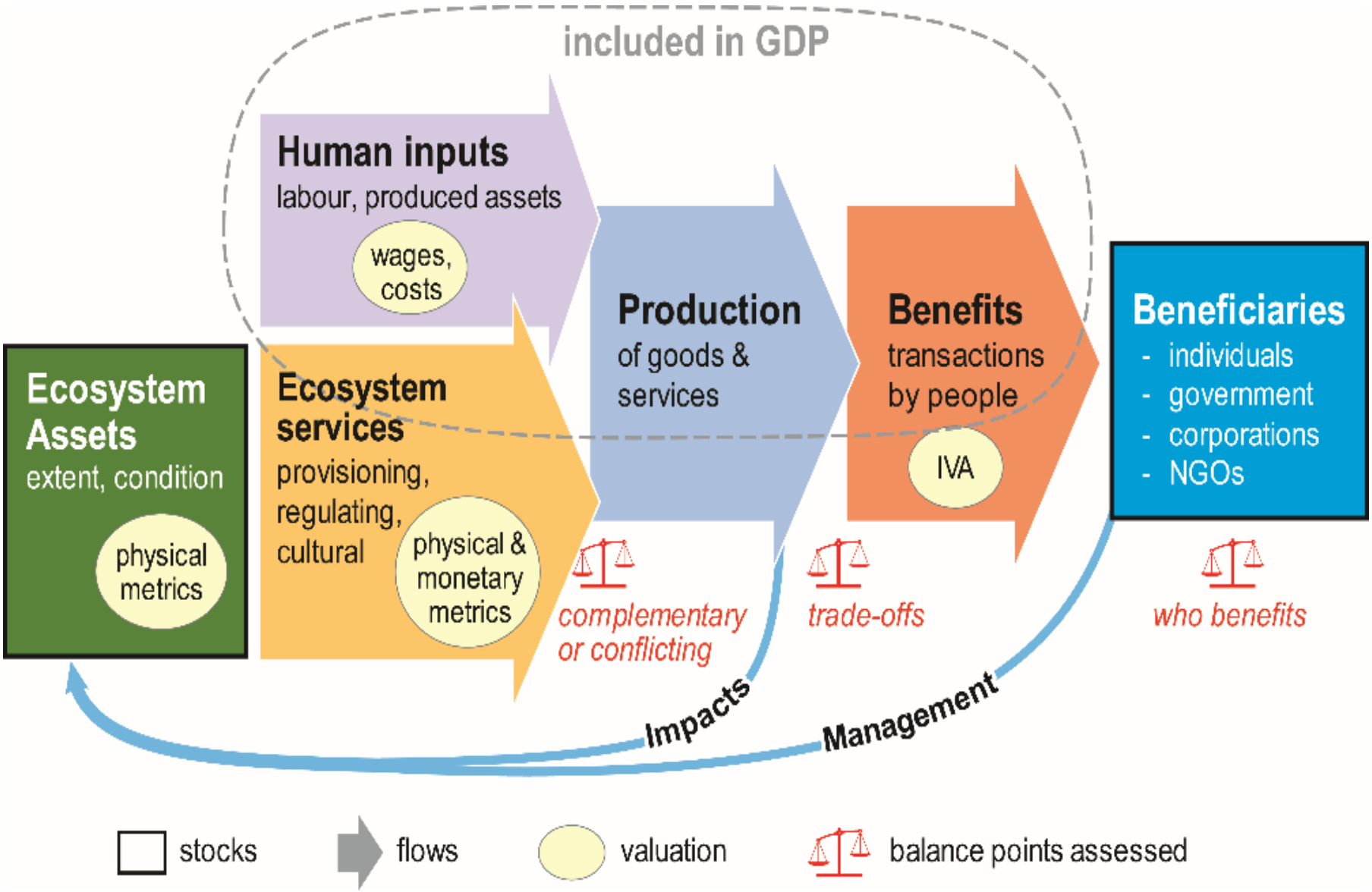
- provides the evidence base to inform decision-making:



- Integrates all assets and services in a region
- Translates environmental values into economic terms
- Allows comparisons within a common framework
- Evaluates trade-offs explicitly and spatially

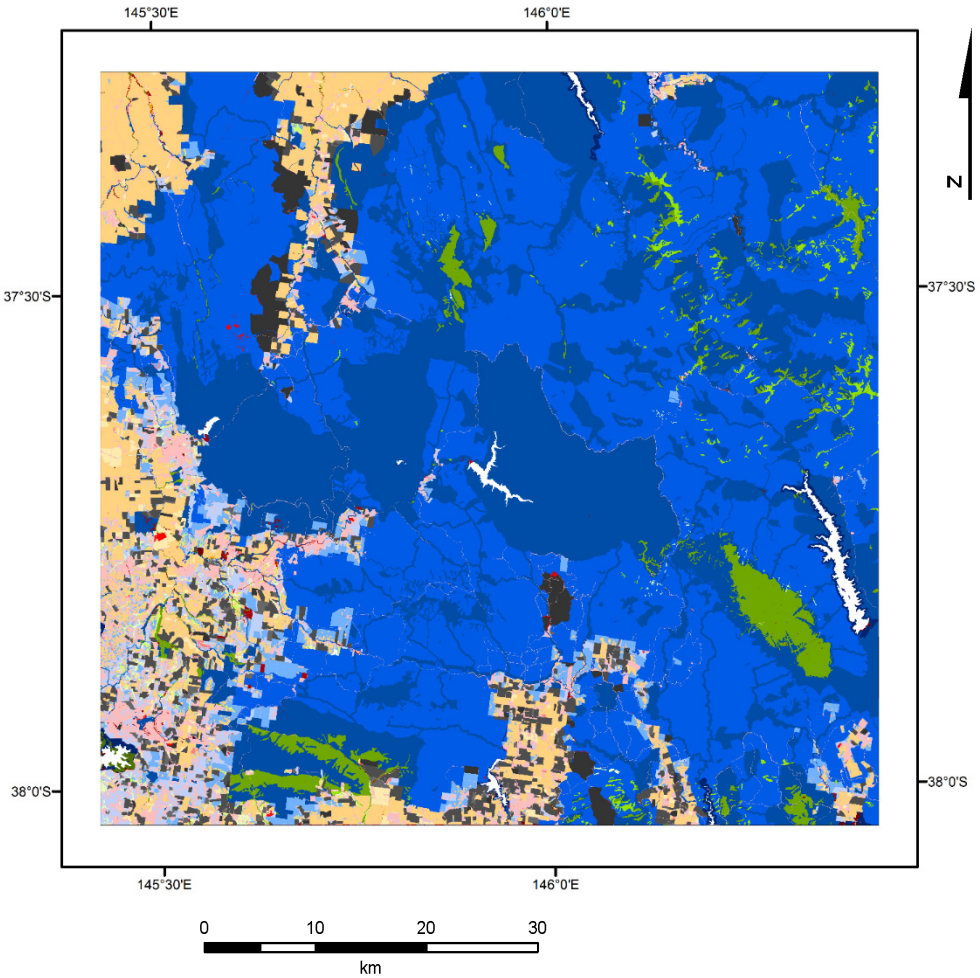
Objective: To provide information in a format relevant to informing decision-making about natural resource management in the region

Model of ecosystem accounting



Production of ecosystem accounts
1. Land account – ecosystem extent

Intersection of land cover and land use forms the spatial framework for the accounts

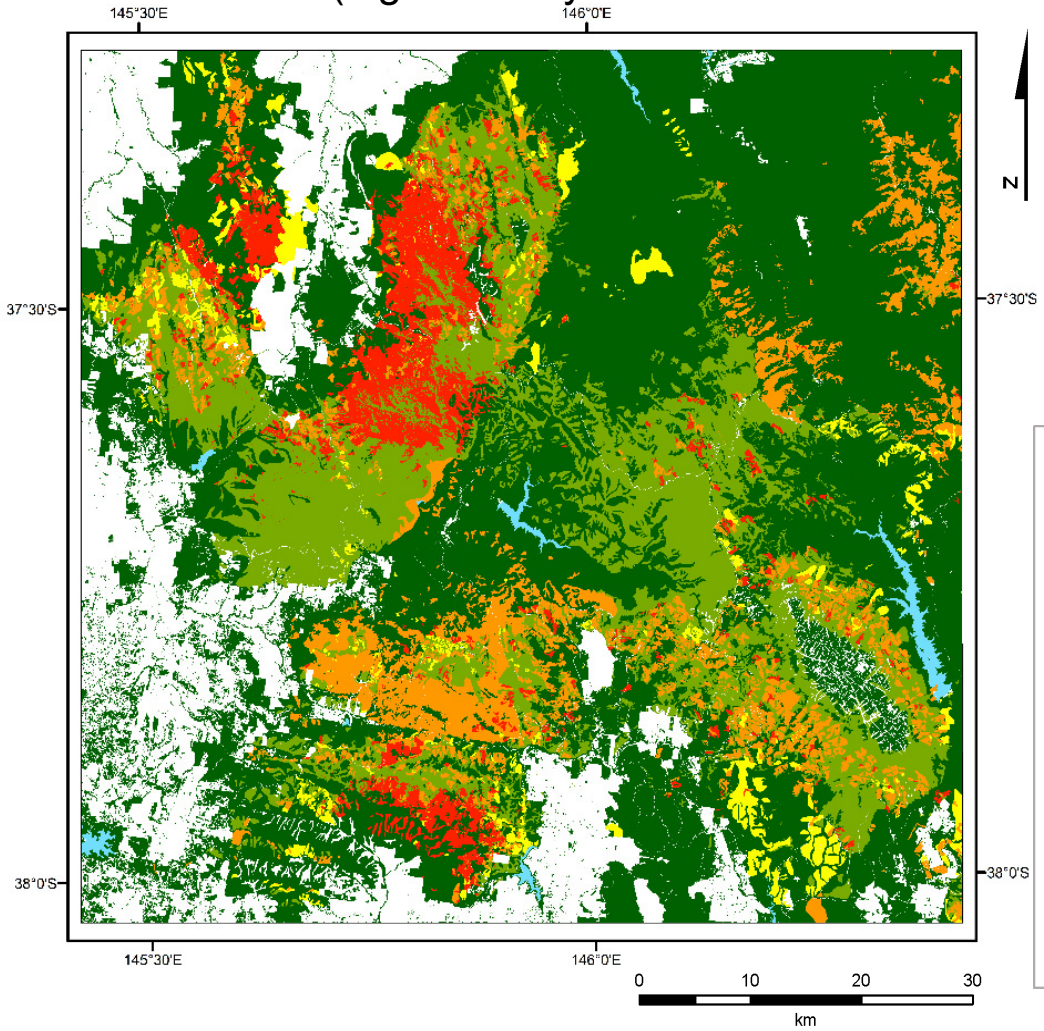


	Land cover	Land use
6, 1	Native forest	urban
6, 2		agriculture
6, 3		plantation production
6, 4		native timber production
6, 5		conservation
6, 6		water supply
5, 1	Native open vegetation	urban
5, 2		agriculture
5, 3		plantation production
5, 4		native timber production
5, 5		conservation
5, 6		water supply
4, 1	Plantation	urban
4, 2		agriculture
4, 3		plantation production
4, 6		water supply
3, 1	Agricultural land	urban
3, 2		agriculture
3, 5		conservation
3, 6		water supply
2, 6	Open water	water supply
1, 1	Bare / built	urban
1, 2		agriculture
1, 3		plantation production
1, 4		native timber production
1, 5		conservation
1, 6		water supply

2. Land account – ecosystem condition

Forest age – influences condition for water yield, carbon storage, biodiversity, timber production, tourism

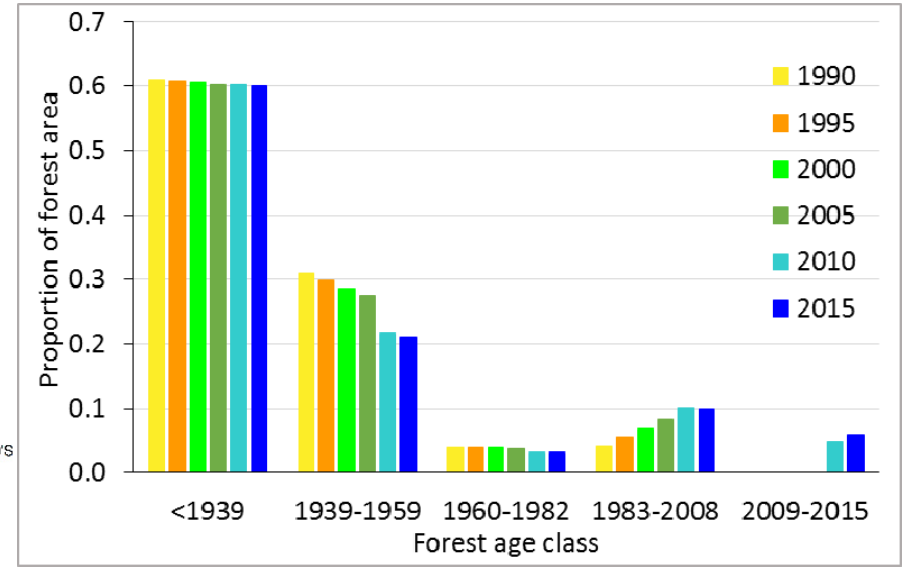
- determined from stand-replacing events of wildfire and logging (high severity wildfire kills montane ash forest but not mixed species forest)



Age Class

	years old	regeneration period
	> 75	before 1939
	56 – 75	1939 – 1959
	33 – 55	1960 – 1982
	7 – 32	1983 – 2008
	0 – 6	2009 - 2015

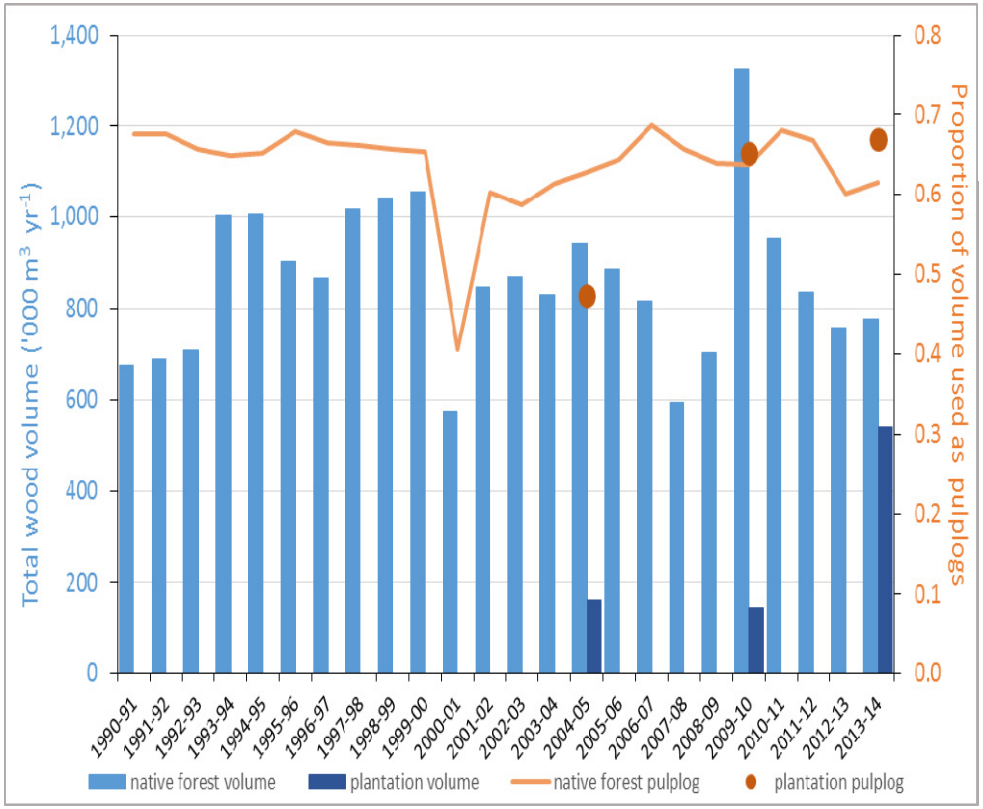
Change in forest age over 25 years



3. Timber accounts

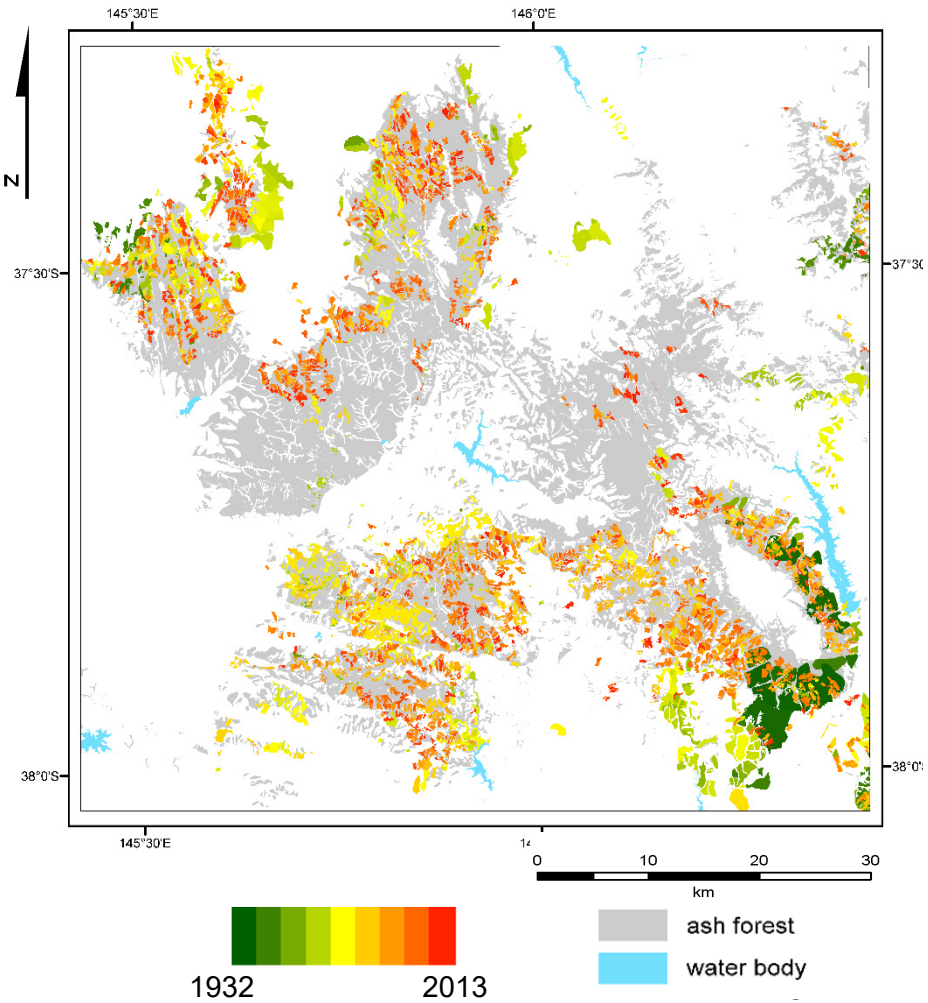
Wood harvested from ash and mixed species native forest, hardwood and softwood plantations.

Annual volume of wood harvested



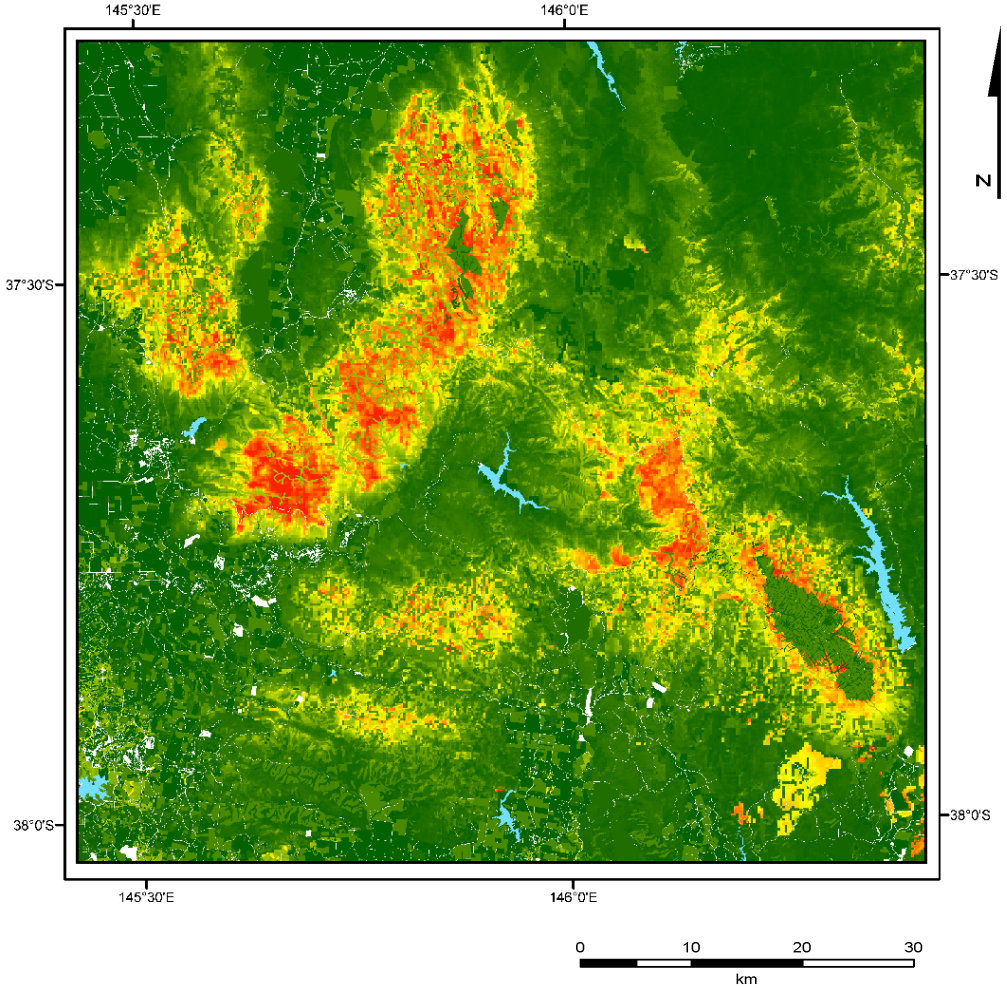
Data Sources:
DSE(2003-09), VicForests(2007-15), ABARES(2016), DotE(2015), HVP(2016)

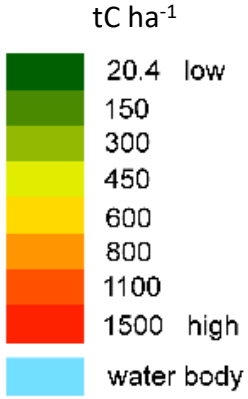
Spatial distribution of historical harvesting



4. Carbon accounts

Spatial distribution of carbon stock density





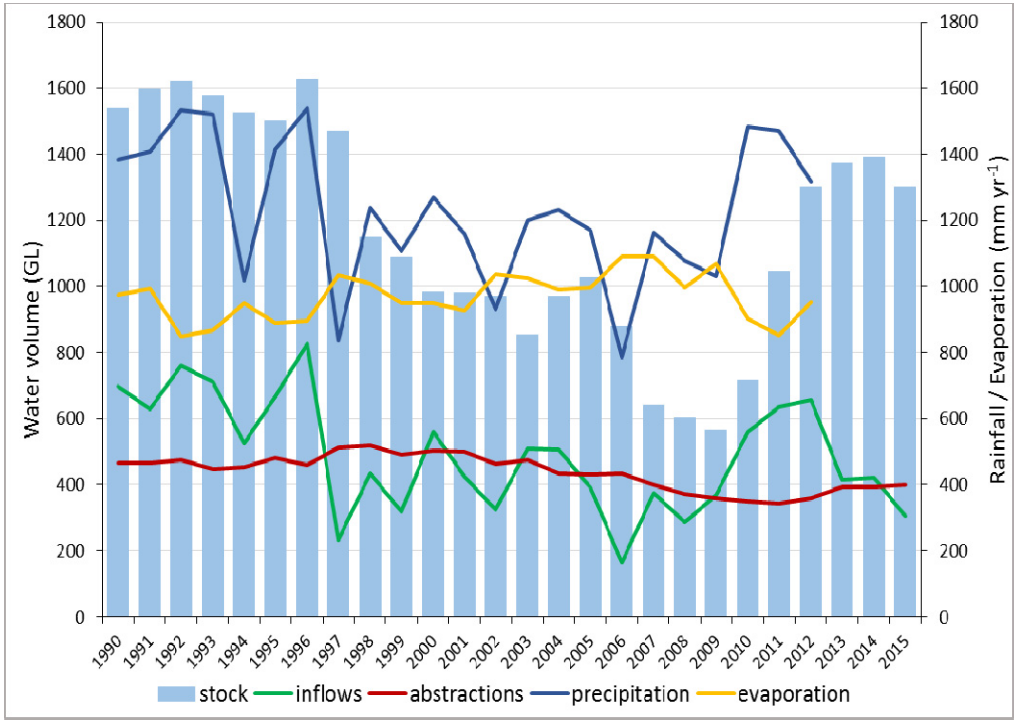
Ecosystem service in the study area:

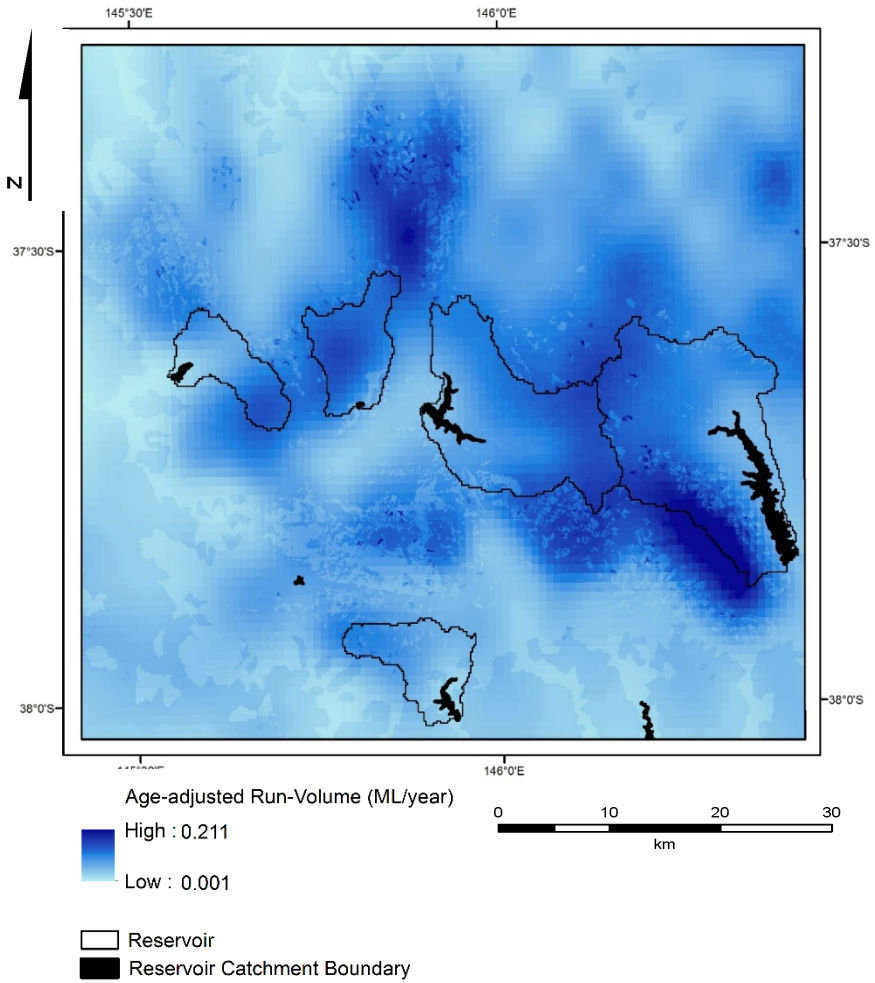
- total stock in 2015 = 146 Mt C
- net annual increment = 1.64 Mt C yr^{-1}
- sequestration potential of re-growing logged forest = 2.98 tC ha^{-1} yr^{-1}

5. Water account

1. Asset account of water stored in the reservoirs (stock)
2. Water provisioning service account of water yield (flow)
3. Water supply as abstractions from the reservoirs (flow)

Spatial distribution of water yield related to environment variables and forest age





6. Biodiversity account

Accounting aims to quantify changes in state of biodiversity in terms of:

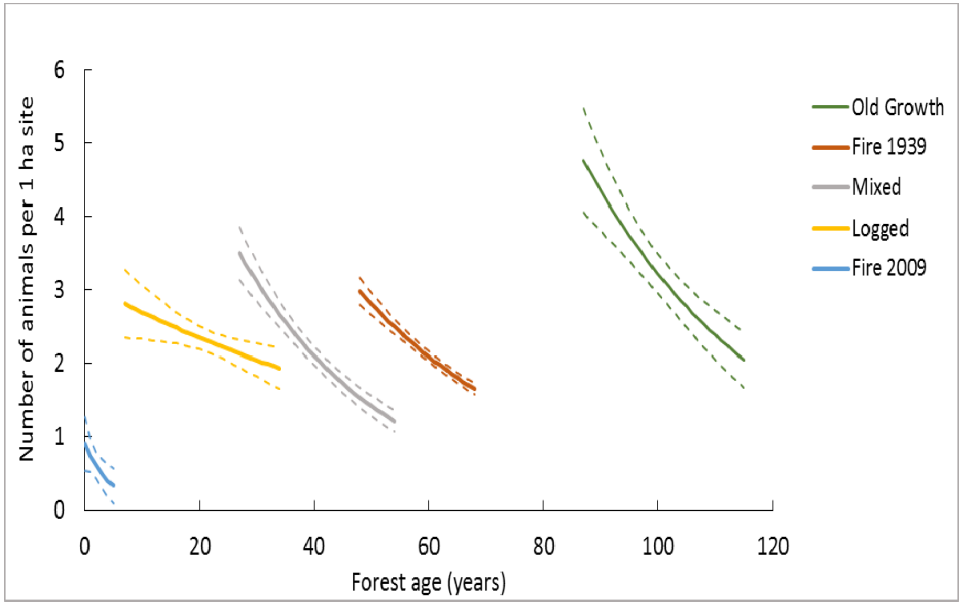
1. Composition **2.** Structure **3.** Function

by applying consistent classifications over time to identify change in condition of populations and their habitat, threatening processes, and extinction risk.

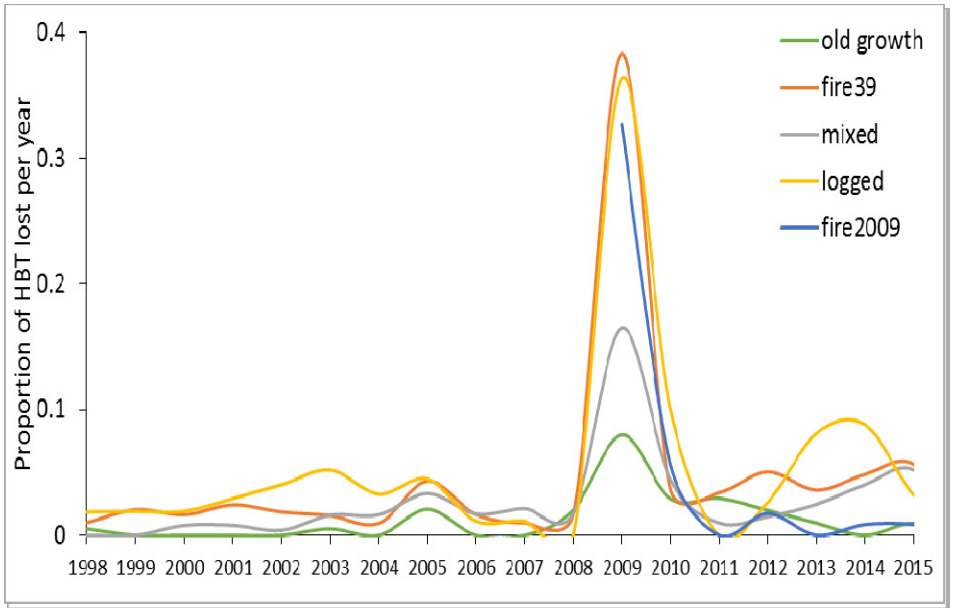
a) Listing of threatened species

	Regionally Extinct	Critically Endangered	Endangered	Vulnerable	Total
2000	2	0	12	14	28
2005	2	1	13	15	31
2010	2	1	13	18	34
2015	2	5	14	17	38
Net change	0	5	2	3	10

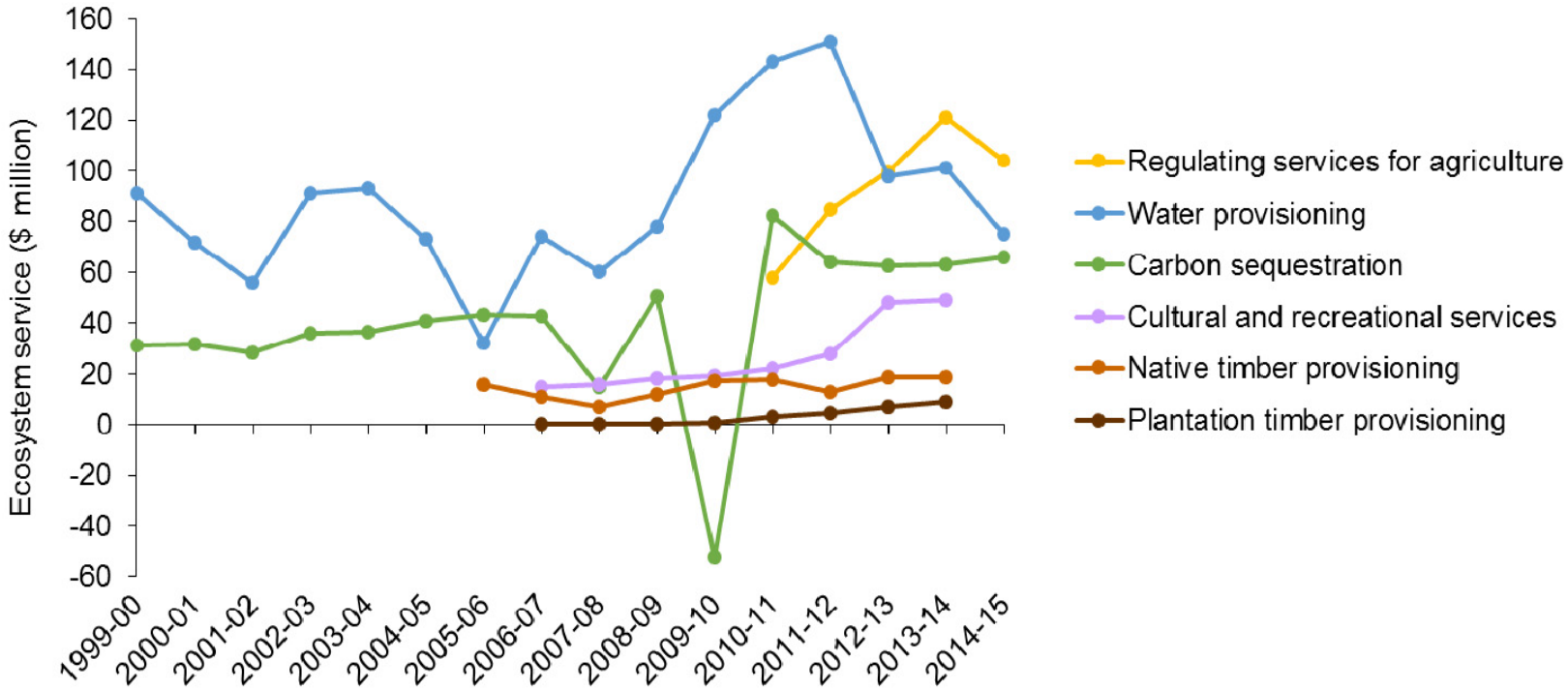
b) Change over time in abundance of arboreal marsupials



d) Loss of habitat attributes – hollow-bearing trees

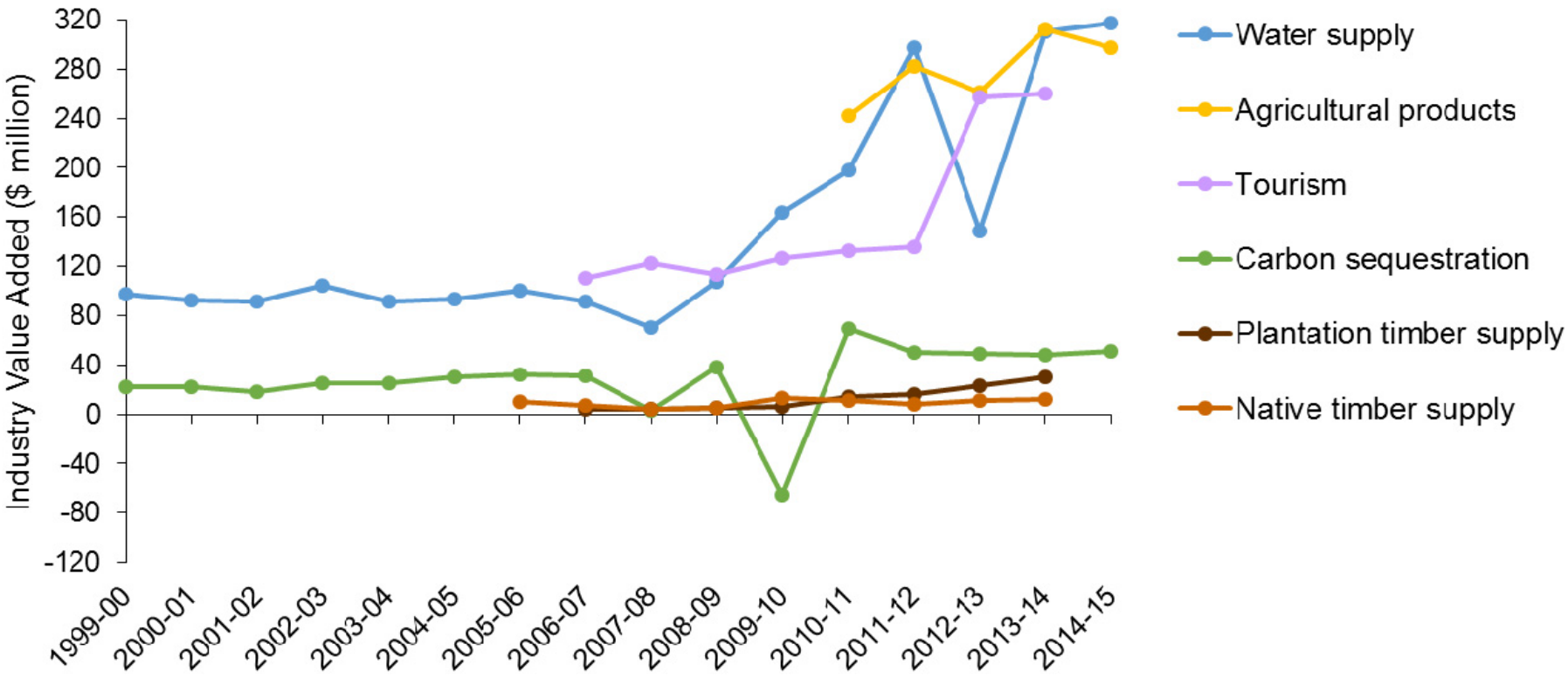


Value of ecosystem services



Ecosystem service	Valuation method	Description
Regulating services for agriculture	unit resource rent	market price less costs of labour, inputs, capital
Water provisioning	replacement cost	cheapest alternative source
Carbon sequestration	payment for service	market based incentive system
Cultural and recreational services	unit resource rent	market price less costs of labour, inputs, capital
Native timber provisioning	stumpage	timber sales less harvest & haulage
Plantation timber provisioning	unit resource rent	market price less costs of labour, inputs, capital

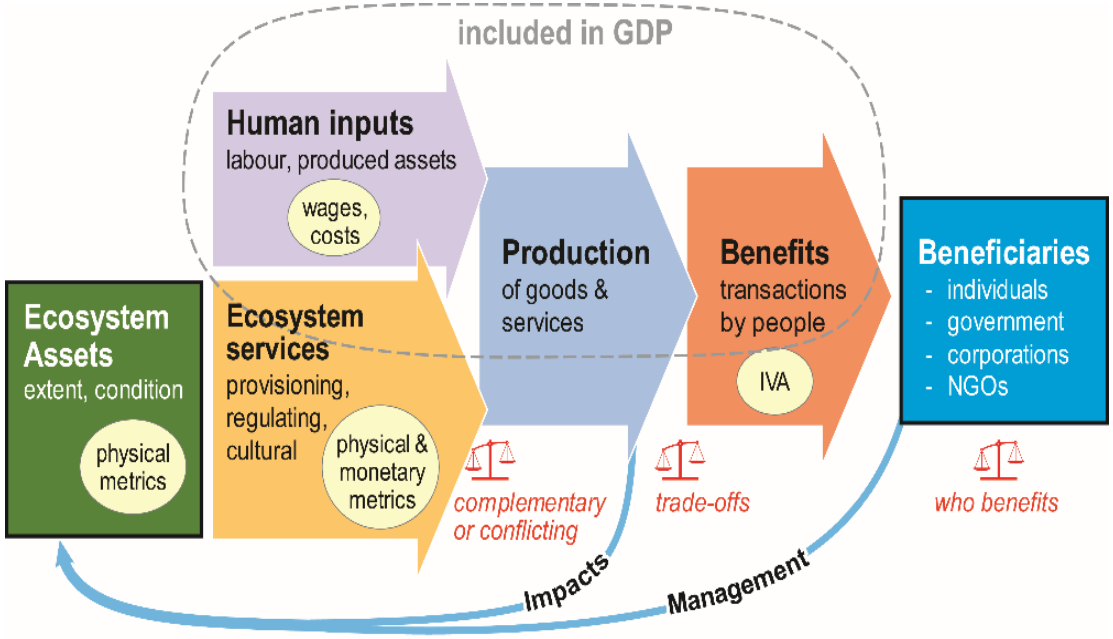
Industry Value Added



IVA is the revenue less costs and wages
IVA is the contribution of the industry to GDP

Note: carbon sequestration is an estimate of potential IVA as there is no current market

Integrating ecosystem accounts



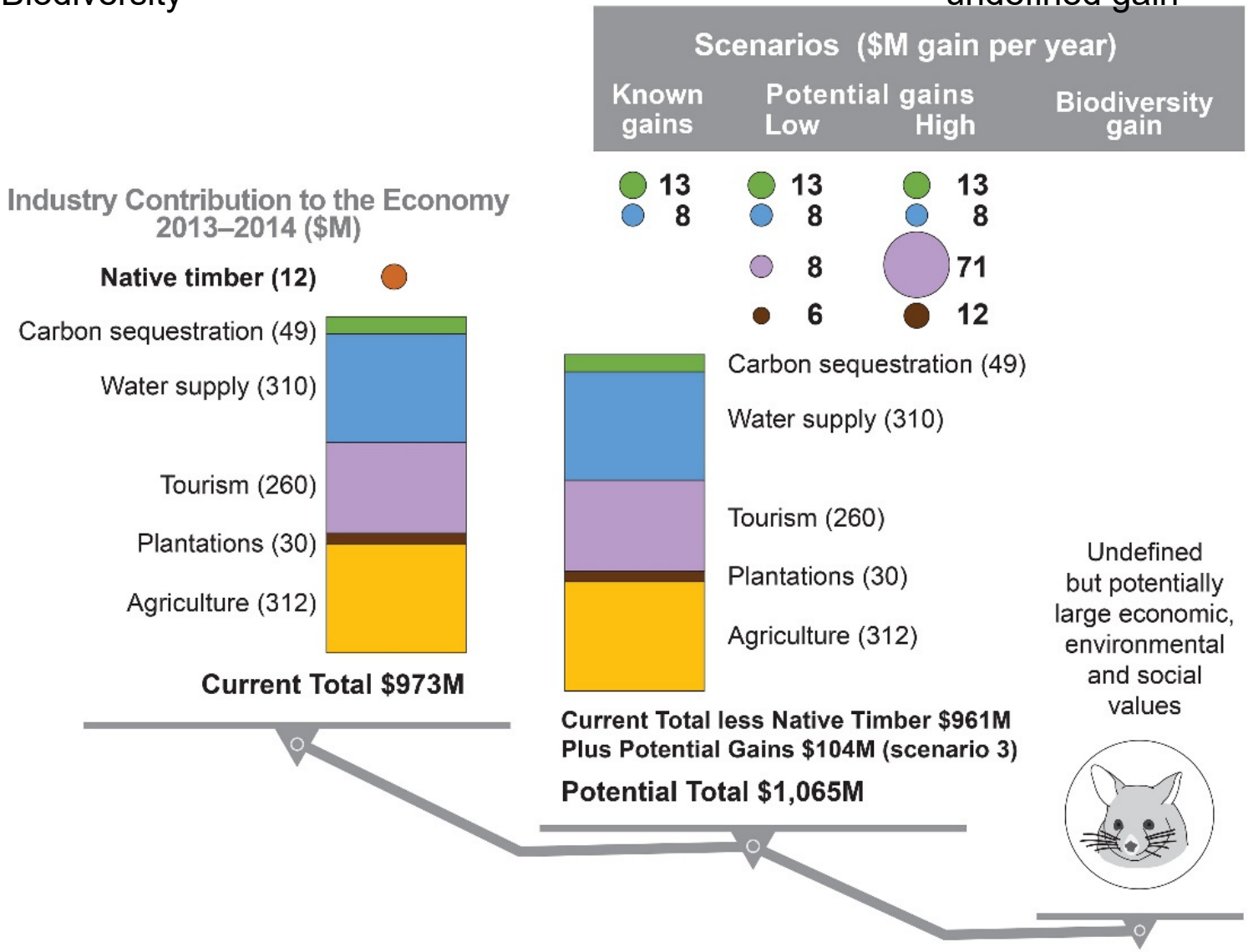
Data for 2013-14

Industry	Ecosystem services	Human inputs			Production	Benefits
		Intermediate consumption	Fixed capital consumption	Wages	Revenue	IVA
Agriculture	121	347	94	49	659	312
Water supply	101	601	187	54	911	310
Tourism	49				485	260
Carbon sequestration	63	14	2	15	63	49
Plantation timber	9	34	8	10	64	30
Native timber	19	50	3	8	62	12

Balancing trade-offs between land use activities

Ceasing native timber harvesting increases ecosystem services for:

- Carbon sequestration and water provisioning – calculated known gain
- Plantation timber provisioning and recreational services – estimate potential gain
- Biodiversity - undefined gain

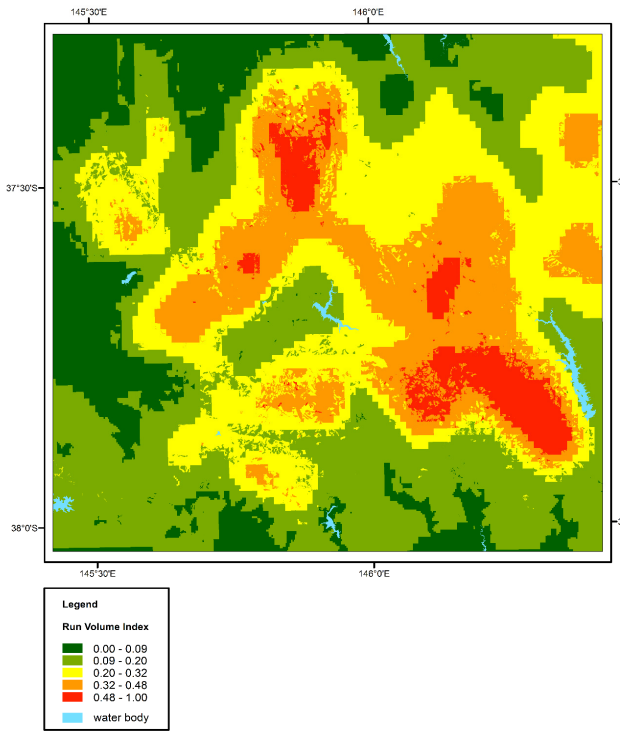


Defining spatial trade-offs

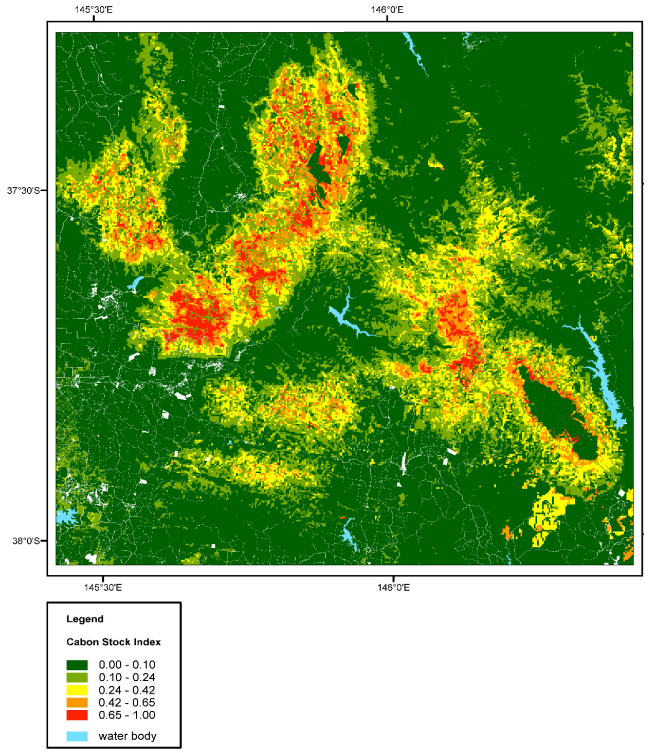
Spatial distribution of ecosystem services

calculated as continuous variables and range-normalized to an index and displayed as five classes

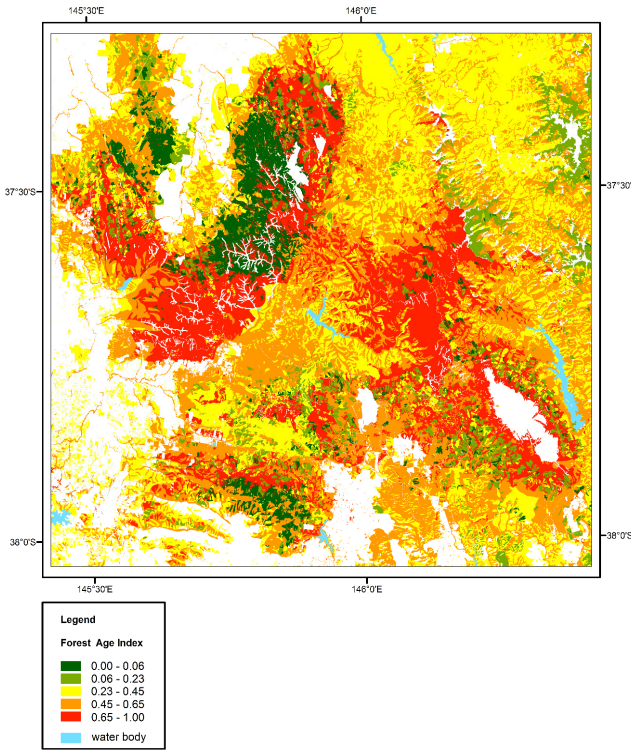
Water yield



Carbon stock density



Native timber



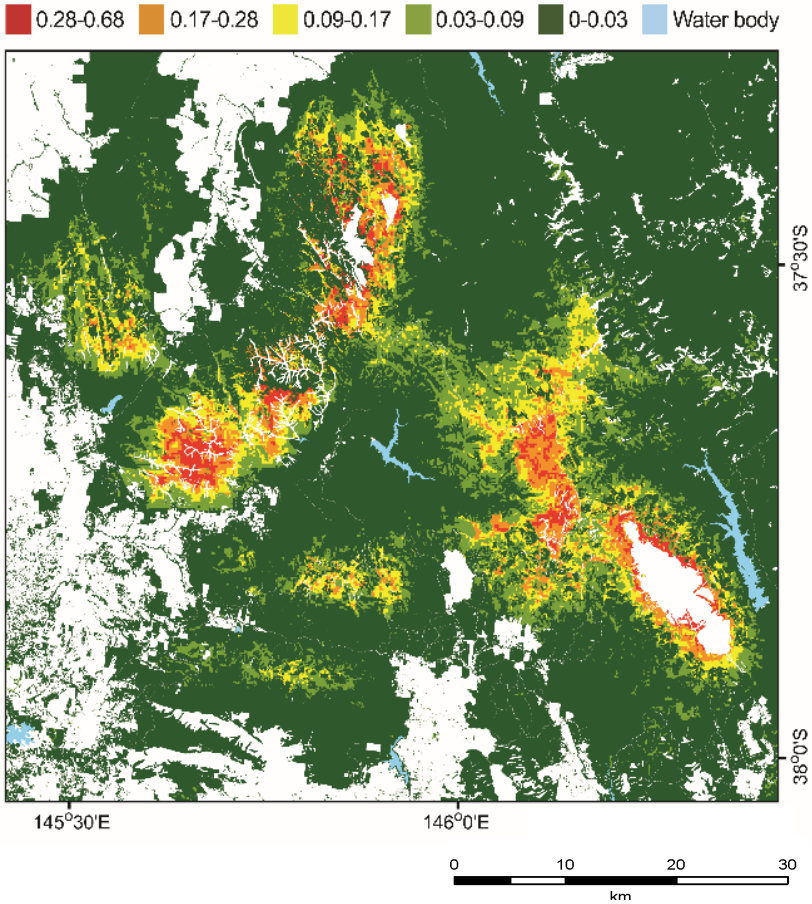
Analysing spatial trade-offs

Interaction index of ecosystem services of water, carbon and timber provisioning.

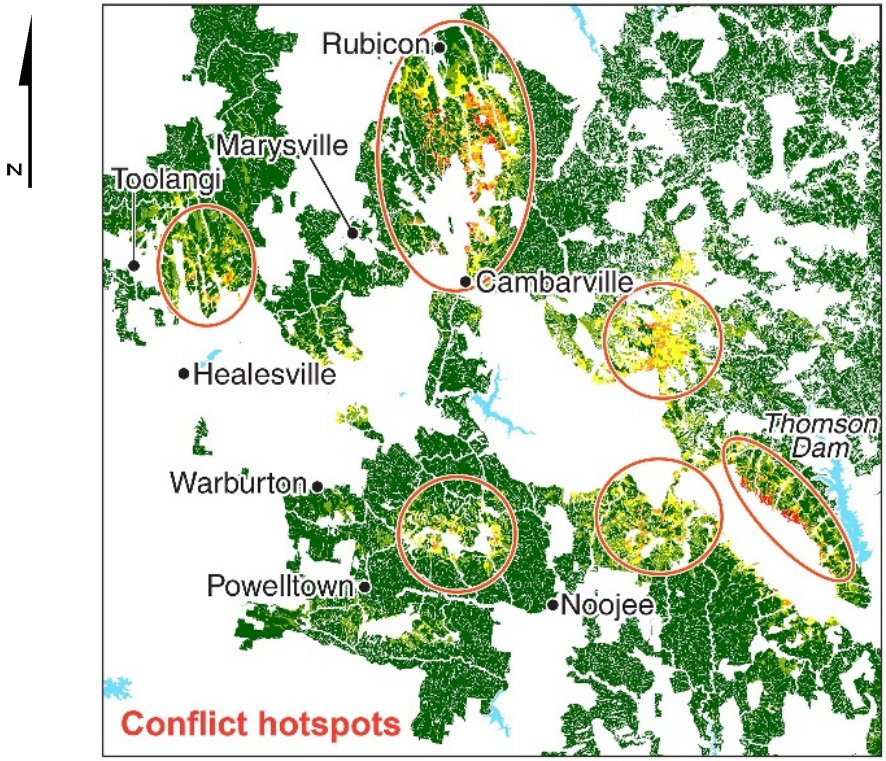
'Hotspots' are the highest values for all ecosystem services.

Trade-offs are required when land uses conflict.

All native forest



Native forest available for harvesting



Evidence from ecosystem accounts to inform natural resource management decision-making

1. Quantified change in ecosystem extent and condition over time and potential drivers from land management

2. Capability to track progress towards targets

3. Valuation of ecosystem services, including those previously unrecognised

4. Valuation of economic uses of ecosystem services by industries and their contribution to the economy

5. Quantified relative values and potential gains and losses involved with impacts and trade-offs between land uses:
   - economic gains from increased water supply and carbon storage exceeded losses from ceasing native timber harvesting

6. Enabling judgements about relative values of conservation of biodiversity and ecosystems:
   - reducing the threat of extinction of a species by conserving habitat is worth the loss of revenue from timber harvesting

7. Identified spatial distributions of high conflict between land uses

Lessons for implementing ecosystem accounting

1. Importance of **long-term data** with consistent methodology and experimental design.
- not just 'big' data; but good, well-designed and long-term monitoring systems.
- data is needed to quantify assets, change over time and ecological processes.

2. Integration of different **scales of data**
– biophysical data at the site scale, spatial data at fixed resolutions, and aggregated economic data over large areas, sectors and industries make attribution difficult.

3. Understanding and quantifying **ecological processes** in terms of:
- functions over time, eg carbon accumulation, decomposition, mortality, reproduction, dispersal
- links across scales, eg relationships between site data and spatial characteristics of ecosystems
- drivers of change, eg disturbance events and degradation processes

4. Implementation of the information in accounts needs to involve understanding drivers of change, interactions and dependencies, vulnerabilities and risks.

5. Boundaries between market and non-market contributions from ecosystem services can be difficult to define. Decisions need to ensure boundaries are defined explicitly and classifications are compatible and mutually exclusive.

6. Improving **links between production and use** of accounts requires a consistent approach
BUT: - maintaining flexibility in methodology appropriate for the ecosystem and objectives,
- research that is independent of immediate use to continually improve methods and concepts

Next steps

Accounting concepts and data:

1. Ecosystem condition – identifying appropriate metrics for quantifying and assessing change over time.
2. Designing monitoring systems to provide data appropriate for ecosystem accounting.
3. Valuation of ecosystem services – approaches to combining physical and monetary metrics in assessments
4. Identifying additional policy and market instruments required to improve resource management, eg carbon sequestration in native forests

What value is a dead tree?

- ✓ home for a possum
- ✓ climate change mitigation
- ✓ soil erosion prevention

Case study:

Ecosystem accounts for the agri-environment system of the Box Gum Grassy Woodlands, a critically endangered ecological community in the wheat-sheep farming belt in south-eastern Australia.

Further Information:

Experimental Ecosystem Accounts for the Central Highlands of Victoria. July 2017.
Heather Keith, Michael Vardon, John Stein, Janet Stein and David Lindenmayer
Final Report - http://www.nespthreatenedspecies.edu.au/publications-tools/experimental-ecosystem-accounts-for-the-central-highlands-of-victoria-full-report-high-res-40mb
Summary Report http://www.nespthreatenedspecies.edu.au/publications-tools/experimental-ecosystem-accounts-for-the-central-highlands-of-victoria-summary
Video http://www.nespthreatenedspecies.edu.au/news/video-environmental-economic-accounts-a-case-study-in-the-victorian-central-highlands

Ecosystem accounts define explicit and spatial trade-offs for managing natural resources.
Heather Keith, Michael Vardon, John Stein, Janet Stein and David Lindenmayer. 2017.
Nature Ecology and Evolution 1: 1683 – 1692.

The Conversation 11/10/2017
https://theconversation.com/money-cant-buy-me-love-but-you-can-put-a-price-on-a-tree-84357